

Microplastics in Soil

Emerging Environmental Concerns

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Introduction

Over the past decade, the environmental impact of plastics has garnered significant attention, especially regarding oceans and marine life. But while most of the focus has been on plastic waste in waterways, a less visible but equally pressing issue is unfolding on land.

Microplastics - tiny plastic particles less than 5

millimetres in size—are making their way into the world's soils, posing potential risks to agriculture, food security, and soil ecosystems. This article explores how microplastics are infiltrating soils, the environmental consequences, and what can be done to mitigate this growing problem.

What are microplastics?

Microplastics are tiny plastic particles that originate from the breakdown of larger plastic debris or are intentionally manufactured for use in products like cosmetics, industrial abrasives, and textiles. They can be categorized into two types:

1. **Primary microplastics:** These are tiny plastic particles intentionally produced for commercial use, such as in personal care products (microbeads) or for industrial purposes.
2. **Secondary microplastics:** These are formed from the breakdown of larger

plastic items, like plastic bags, bottles, or fishing nets, due to environmental factors such as sunlight, heat, and physical abrasion.

While much research has focused on microplastics in aquatic environments, recent studies reveal that soils may actually harbor even higher concentrations of these particles. This is an emerging concern because soils are critical for agriculture, water filtration, and biodiversity, and contamination could have far-reaching effects.

How do Microplastics Enter Soils?

Microplastics can enter soils through a variety of pathways:

1. **Agricultural Practices:** One of the largest sources of microplastic contamination in soils is the use of plastic mulch films, which

are widely employed in agriculture to suppress weeds, retain soil moisture, and enhance crop yields. Over time, these films degrade and break down into smaller

plastic fragments, which are then incorporated into the soil.

2. **Sludge from Wastewater Treatment:** Wastewater treatment plants are not equipped to filter out microplastics, and as a result, sewage sludge, often used as fertilizer, contains a significant amount of microplastics. When this sludge is spread over agricultural fields, it introduces plastic particles directly into the soil.
3. **Compost:** Organic compost used in agriculture and gardening can also be a source of microplastic contamination. Compost made from food waste, yard trimmings, and other organic materials often contains plastic fragments, which

accumulate in soils when the compost is applied.

4. **Atmospheric Deposition:** Microplastics can also be carried by the wind and deposited onto soils. Studies have shown that microplastics can travel significant distances through the air, contaminating even remote areas.

Littering and Runoff: Plastic waste from urban and rural areas often ends up in the soil through littering, improper waste management, and surface water runoff during rainstorms. This is especially common near roads, where tire wear particles (a form of microplastic) contribute to soil contamination.

The Environmental Impact of Microplastics in Soils

While the impact of microplastics in marine environments has been well-documented, research on their effects in soils is still in its early stages. However, emerging evidence suggests that microplastics in soils pose a significant threat to ecosystems, agriculture, and human health.

1. **Soil Structure and Function:** Microplastics can alter the physical properties of soils, such as porosity, water retention, and drainage. Studies suggest that the presence of microplastic particles can disrupt the natural structure of soil, making it more compacted and less able to absorb water. This can hinder plant growth and exacerbate issues such as soil erosion and drought.
2. **Harm to Soil Organisms:** Soil is home to a vast array of organisms, from earthworms and insects to bacteria and fungi, all of which play a critical role in maintaining soil health. Microplastics can negatively affect these organisms by obstructing their digestive systems, leaching toxic chemicals, or even causing physical damage. For example, earthworms that ingest microplastics may experience reduced mobility, feeding, and reproduction rates, which can disrupt the entire soil ecosystem.
3. **Chemical Contamination:** Microplastics often contain chemical additives such as

phthalates, bisphenol A (BPA), and flame retardants, which can leach into the soil and be absorbed by plants. These chemicals are known to be harmful to both animals and humans, and their presence in soils raises concerns about contamination of the food chain. Moreover, microplastics can act as vectors for other environmental pollutants, such as heavy metals and pesticides, increasing the risk of soil and crop contamination.

4. **Impact on Plant Growth:** Although research is still ongoing, early studies suggest that microplastics may affect plant growth by altering soil properties or directly interacting with plant roots. Changes in water availability, nutrient uptake, and soil compaction caused by microplastics could reduce crop yields and affect food security.
5. **Potential Human Health Risks:** Microplastics in soils can make their way into the human food chain through various routes, including crops grown in contaminated soils, animals that ingest microplastics, or through drinking water. While the long-term health effects of microplastic exposure in humans are not fully understood, there is growing concern about their potential to cause harm, particularly due to the chemicals they contain.

Microplastics and Agriculture: A Growing Concern

Agriculture is particularly vulnerable to microplastic contamination due to the widespread use of plastic products in farming practices. The reliance on plastic mulch films, irrigation systems, and fertilizers made from sludge or compost has inadvertently introduced large amounts of plastic into agricultural soils. Over time, these plastics break down into microplastics, which can accumulate and persist in the soil for decades or longer. In

addition to harming soil health, the presence of microplastics in agricultural fields raises concerns about food safety. Crops grown in contaminated soils may absorb microplastic particles or the chemicals they carry, leading to potential exposure for consumers. This is a significant issue for food production, as microplastics have been detected in various fruits, vegetables, and grains in studies around the world.

Reducing Microplastic Pollution in Soils

While the issue of microplastics in soil is a growing concern, there are steps that can be taken to mitigate their impact and prevent further contamination. Addressing this problem will require action from governments, industries, farmers, and consumers.

1. **Reduce Plastic Use in Agriculture:** Farmers can reduce their reliance on plastic products by adopting more sustainable alternatives. For example, biodegradable mulch films made from natural materials can be used in place of traditional plastic films. Additionally, practices such as agroforestry, cover cropping, and organic farming can help improve soil health without the need for plastic inputs.
2. **Improve Waste Management:** Proper waste management is essential for preventing plastic pollution in the environment. Governments should invest in better recycling infrastructure and regulations to ensure that plastic waste is properly disposed of. Additionally, efforts to reduce the use of single-use plastics can

help limit the amount of plastic entering soils.

3. **Regulate Microplastic Additives:** Banning or regulating the use of microplastics in consumer products, such as cosmetics and cleaning agents, can help reduce the primary sources of microplastic pollution. Some countries have already implemented bans on microbeads, but more comprehensive action is needed globally.
4. **Develop Soil Remediation Techniques:** Researchers are exploring ways to remove microplastics from soils, though effective methods are still in development. Techniques such as bioremediation, where organisms are used to break down or remove pollutants, hold promise but require further research and testing.
5. **Raise Awareness:** Educating the public about the issue of microplastics in soils is critical for driving change. Consumers can make a difference by reducing their plastic use, supporting policies that limit plastic pollution, and advocating for sustainable agricultural practices.

Conclusion

Microplastics in soil represent an emerging environmental concern with potentially serious consequences for ecosystems, agriculture, and human health. While much remains to be understood about the full impact of these tiny particles, there is growing evidence that their presence in soils is a significant problem that must be addressed. As the world becomes increasingly aware of the dangers of plastic

pollution, it is important to recognize that this issue extends beyond oceans and waterways. Our soils, which provide the foundation for life on Earth, are at risk of becoming a reservoir for plastic waste. By taking action now to reduce microplastic pollution and protect soil health, we can ensure a sustainable future for agriculture, biodiversity, and the planet as a whole.